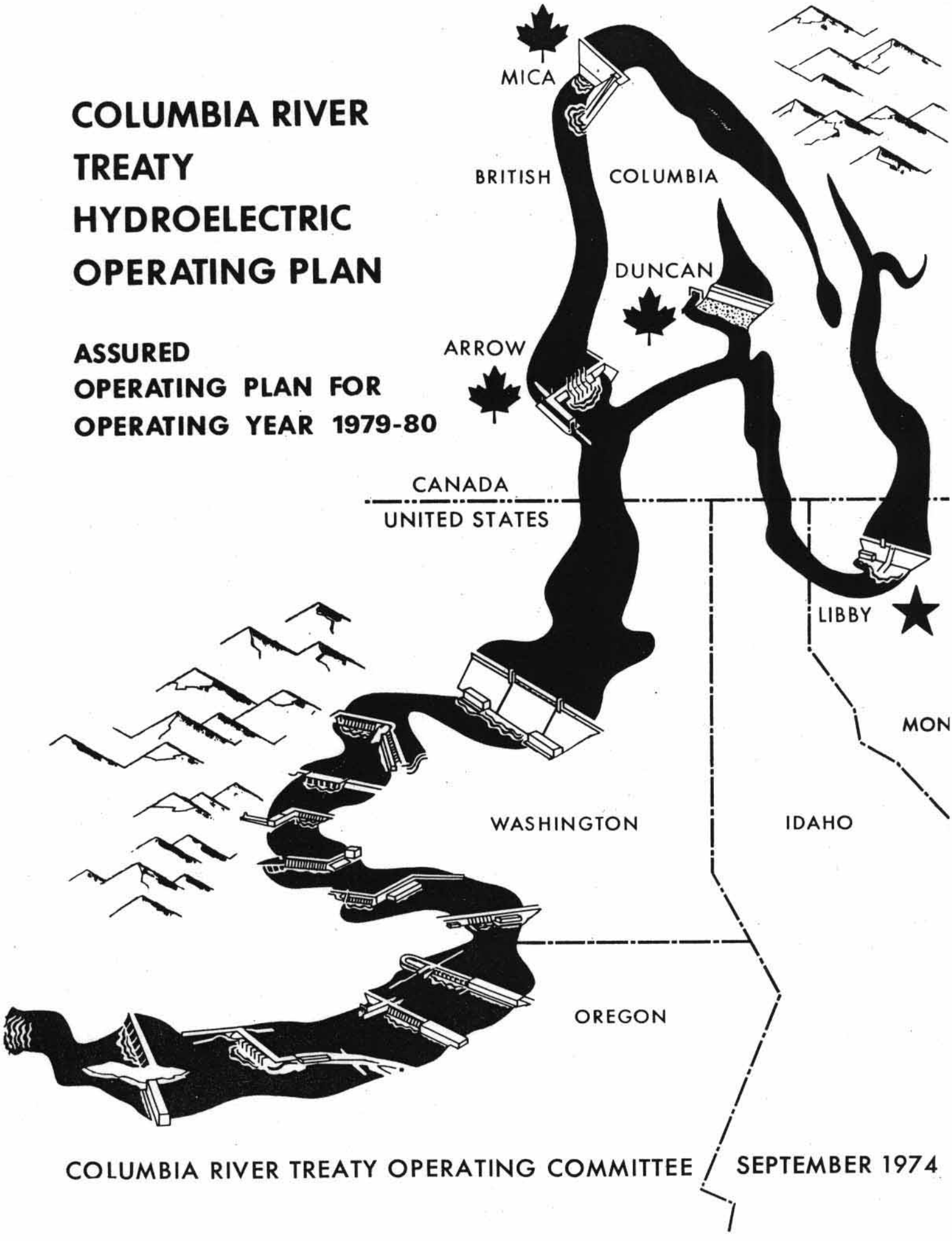
COLUMBIA RIVER TREATY HYDROELECTRIC OPERATING PLAN

ASSURED OPERATING PLAN FOR OPERATING YEAR 1979-80



COLUMBIA RIVER TREATY OPERATING COMMITTEE / SEPTEMBER 1974

C O L U M B I A R I V E R T R E A T Y

AGREEMENT

on

HYDROELECTRIC OPERATING PLAN FOR TREATY STORAGES

OPERATING YEAR 1979-80

The Columbia River Treaty between the United States and Canada requires that hydroelectric operating plans be agreed in advance by the Entities for the operation of the storages provided in the Treaty. The Canadian Entity and the United States Entity agree that the Treaty storages will be operated in accordance with the attached "Columbia River Treaty Hydroelectric Operating Plan, Assured Operating Plan for Operating Year 1979-80," dated September 1974.

W. D. Kennedy
Chairman
Canadian Entity

Donald Paul Hodel
Chairman
United States Entity

September 27, 1974
Date of Agreement

COLUMBIA RIVER TREATY
HYDROELECTRIC OPERATING PLAN

Assured Operating Plan for
Operating Year 1979-80

TABLE OF CONTENTS

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HYDROELECTRIC OPERATING PLAN

Assured Operating Plan for
Operating Year 1979-80

INTRODUCTION

The Treaty between Canada and the United States of America relating to the cooperative development of the water resources of the Columbia River Basin requires that each year an Assured Operating Plan be agreed by the Entities for the operation of the Columbia River Treaty Storage in Canada during the sixth succeeding year. This plan will provide to the Entities information for the sixth succeeding year for planning the power systems in their respective countries which are dependent on or coordinated with the operation of the Canadian storage projects. The data assumed for this Assured Operating Plan will undergo review by the Entities immediately prior to the 1979-80 operating year and such data may be revised to reflect data and criteria current at that time. Should the Entities fail to agree on such revisions, then this Assured Operating Plan will form the basis for the Detailed Operating Plan for 1979-80.

This Assured Operating Plan was prepared in accordance with the Principles and Procedures for the Preparation and Use of Hydroelectric Operating Plans for Canadian Treaty Storage[1/]. It is based on criteria contained in Annex A and Annex B of the Columbia River Treaty[2/], Article VII of the Protocol[3/], and Section B.1. of the Terms of Sale[4/]. The other operating criteria reflected in this plan is the Columbia River Treaty Flood Control Operating Plan[5/].

The Assured Operating Plan consists of:

(a) The Operating Rule Curve for the whole of the Canadian Treaty Storage, including the Critical Rule Curve, Assured Refill Curve, Variable Refill Curves, and the individual project Flood Control Storage Reservation Curves.

(b) Operating Rules which specifically designate criteria for operation of the Canadian Treaty Projects in accordance with the principles contained in the above references.

A 30-year System Regulation Study[6/] was utilized to develop and test the operating rules and rule curves. It contains the agreed-upon operating constraints such as maximum and minimum project elevations and discharges.

SYSTEM REGULATION STUDIES

In accordance with Annex A, Paragraph 7, of the Treaty, the Columbia River Operating Committee conducted system regulation studies reflecting Canadian storage operation for optimum generation in both Canada and the United States. Downstream power benefits were computed with the Canadian storage operation based on the operating rules specified herein. There is no reduction of the Canadian Entitlement of downstream power benefits.

System Regulation Studies for the Assured Operating Plan were based on 1979-80 estimated loads and resources in British Columbia and in the United States Pacific Northwest System. Historical flows for the period July 1928 through June 1958, modified to estimated 1979-80 conditions[7/], were used.

The Critical Rule Curve for these studies was determined from Bonneville Power Administration Study 80-41. The study indicated a 42-½ month

critical period for the United States system resulting from the low flows during the period from 16 August 1928 through February 1932. It was assumed that all reservoirs, both in the United States and Canada, were full at the beginning of the critical period.

In the studies, individual project flood control criteria were followed. Although only 7.0 million acre-feet of storage content at Mica is committed for power operation purposes under the Treaty, the studies are based on a full storage content of 20 million acre-feet to test compatibility with flood control parameters. Flood Control and Variable Refill Criteria are based on historical inflow volumes.

DETERMINATION OF OPTIMUM GENERATION IN CANADA AND THE UNITED STATES

In order to determine whether optimum generation in both Canada and the United States was achieved in the system regulation studies, the following three quantities were computed for both the Canadian and United States systems:

(a) firm energy capability

(b) dependable capacity

(c) average annual usable secondary energy.

In the studies for the 1979-80 Assured Operating Plan the Canadian storage operation was modified to achieve a combined sum of the three quantities that was greater than the combined sum achieved under an operation of Canadian storage for optimum generation in the United States alone.

The following table shows the results from the studies adopted for the 1979-80 Assured Operating Plan and from studies designed to achieve optimum generation in the United States.

COMPARISON OF STUDY RESULTS

	Optimum Generation in Canada and the U.S.	Optimum Generation in the U.S.	Loss	Gain
1. Firm Energy Capability (Av. MW)				
U.S. System	12,392	12,395		
Canada (Mica)	882	871		
Total (Av. MW)	13,274	13,266		8
2. Dependable Capacity (MW)				
U.S. System	28,593	28,909		
Canada (Mica)	1,572	1,231		
Total (MW)	30,165	30,140		25
3. Average Annual Usable Secondary Energy (Av. MW)				
U.S. System	2,721	2,741		
Canada	3 *			
Total (Av.)	2,724	2,741	17	

* Gain in usable energy produced at Mica in the study for optimum generation in Canada and the U.S.

The Columbia River Treaty Operating Committee agreed that for the 1979-80 Assured Operating Plan the three quantities would be assigned the following relative values:

> firm energy (Av. MW): dependable capacity (MW): average annual usable secondary energy (Av. MW) were related in the ratio 3:1:2.

The three quantities were added after weighting on this basis and there was a net gain to the combined Canadian and United States systems with the study designed for optimum generation in Canada and the United States.

OPERATING RULE CURVES

The operation of Canadian storage during the 1979-80 Operating Year shall be guided by an Operating Rule Curve for the whole of Canadian storage, and by Flood Control Storage Reservation Curves for the individual projects. The Operating Rule Curve is derived from the various curves described below. These curves are first determined for the individual Canadian storages and then summed to obtain the values for the whole of usable Canadian storage given by the composite tables included in this Plan. This is in accordance with the provision of Article VII(2) of the Protocol.

(a) Critical Rule Curve. The Critical Rule Curve indicates the end-of-month storage content of Canadian storage during the critical period. It is designed to protect the ability of the

United States system to serve firm load and to protect the firm level of Mica generation with the occurrence of flows no worse than those during the most adverse historical streamflow period. A tabulation of the Composite Critical Rule Curve for the whole of Canadian storage is included as Table 1.

(b) Refill Curve. The Refill Curve is a guide to operation of Canadian storage which defines the normal limit of storage draft for secondary energy in order to provide a high probability of refilling the storage. In general, the Operating Plan does not permit serving secondary loads at the risk of failing to refill storages and thereby jeopardizing the firm load carrying capability of the system or the Mica generating plant during subsequent years. The end of the refill period is considered to be 31 July.

The Refill Curve is, in turn, defined by two curves as discussed below. In each case, adjustment should be made for water required for refill of upstream reservoirs when applicable.

(1) Assured Refill Curve. The Assured Refill Curve indicates the end-of-month storage content required to assure refill of Canadian storage based on the 1930-31 water year, the system's second lowest historical volume of inflow for the period January through July as measured at The Dalles, Oregon. The tabulation of the composite Assured Refill Curve for the whole of Canadian storage is included as Table 2.

The curve was based on higher flows than the minimum discharge requirements for the period January through July. The schedule of outflows is the same as the Power Discharge Requirements used in computing the Variable Refill Curve discussed in (2) below when The Dalles volume runoff is less than 80 million acre-feet.

(2) Variable Refill Curve. The Variable Refill Curve gives end-of-month storage contents for the period January through July required to refill Canadian storage based on historical inflow volume and specified Power Discharge Requirements during the refill period. In the system regulation studies the Power Discharge Requirement was made a function of the natural January - July runoff volume at The Dalles, Oregon. In those years when this volume was lower than 80 million acre-feet, the discharge used was that required to meet firm loads while refilling. In years when the runoff volume at The Dalles exceeded 95 million acre-feet the Power Discharge Requirement was the project minimum outflow. For intermediate volumes the Power Discharge Requirement was interpolated linearly between the values shown below. The following are the January through July Power Discharge Requirements used in computing the Variable Refill Curves:

Power Discharge Requirements in cfs
For January through July Volume at The Dalles

	80 MAF			90 MAF			95 MAF
Project	Jan Feb Mar	Apr May Jun	Jul	Jan Feb Mar	Apr May Jun	Jul	All Periods
Mica	3,000	11,600	14,600	3,000	6,300	8,300	3,000
Arrow	5,000	24,200	41,000	5,000	13,200	16,000	5,000
Duncan	100	1,700	1,700	100	900	900	100

Composite Variable Refill Curves for the whole of Canadian storage for the 30 years of historical record are recorded as Table 3. These illustrate the probable range of these curves based on historical conditions. In the actual operation in 1979-80, the Power Discharge Requirements will be based on the forecast of unregulated runoff at The Dalles.

(c) Flood Control Storage Reservation Curve. The Flood Control Storage Reservation Curves[8/] give end-of-month storage content to which each individual Canadian storage project shall be evacuated for flood control and other requirements during the Storage Evacuation Period. During the Flood Control Refill Period the flood control curves used in the studies were developed from daily system regulation studies. They reflect the use of historical inflow volumes. Flood control curves for the thirty-year study period are shown on Tables 4, 5 and 6. Tables 5 and 6 reflect an assumed transfer of 2 million acre-feet of storage space from Arrow to Mica. In actual operation, the Flood Control Storage Reservation Curves will be based on the Flood Control Operating Plan, using the latest forecast of runoff available at that time.

(d) Definition of Operating Rule Curve. Prior to 1 January, the Operating Rule Curve is defined by the Critical Rule Curve or the Assured Refill Curve, whichever is higher. The Critical Rule Curve for the first year of the critical period is used in the foregoing determination. Beginning 1 January, the Operating Rule Curve is defined by first determining the higher of the Critical Rule Curve and the Assured Refill Curve; the Operating Rule Curve is the lower of the above-determined value or the Variable Refill Curve. Also, in all periods the Operating Rule Curve meets all requirements for flood control operation (except as noted in paragraph (d) of the Operating Rules). Composite Operating Rule Curves for the whole of Canadian storage for all 30 years of historical record are included as Table 7 to illustrate the probable future range of these curves based on historical conditions.

OPERATING RULES

The following rules, used in the System Regulation Study, will apply to the operation of Canadian storage in the 1979-80 Operating Year.

(a) The whole of the Canadian storage may be drafted to its Operating Rule Curve as required to produce optimum generation in Canada and the United States in accordance with Annex A, Paragraph 7, of the Treaty, subject to project physical characteristics, operating constraints, and the criteria for the Mica project listed in (e) below.

(b) The whole of the Canadian storage will not be drafted below its Operating Rule Curve unless:

(1) Reservoir storage in the United States system has been drafted to its refill curve.

(2) Deliveries of secondary energy in the United States are discontinued.

(3) Committed firm thermal and miscellaneous resources not displaced by surplus firm hydro resources are in operation or other replacement energy has been secured from sources other than those committed.

(c) When the conditions of (b) above are met, and it is necessary to draft additional storage to produce optimum generation as determined by the Critical Period System Regulation study, the whole of the Canadian storage and reservoir storage in the United States system will be drafted proportionately between its Operating Rule Curve or Energy Content Curve, respectively, and its Critical Rule Curve. The proportionate draft will be made, if necessary, first to the first year Critical Rule Curve, then

between the first and second year Critical Year Rule Curve, the second and third year Critical Rule Curve, etc. When it is necessary to operate the whole of the Canadian storage and the United States reservoir storage below their lowest Critical Rule Curves, each shall be operated proportionately between its lowest Critical Rule Curve and its normal minimum content, except that Mica Reservoir will continue to be operated in accordance with (e) below, so as to optimize generation at site as well as downstream in the United States.

(d) Each project will be operated on or below the storage content defined by its Flood Control Storage Reservation Curve, unless such content is below that indicated by the Variable Refill Curve.

(e) Mica project will be operated to the following monthly criteria as qualified in (1) to (4) below:

Mica Project Operating Criteria

Month	Target End-of-Period Storage Content (KSFD)	Target Average Outflow (CFS)	Minimum Outflow (CFS)	Maximum Outflow (CFS)
July	9990.2	N/A	10,000	N/A
August 1-15	9990.2	N/A	10,000	N/A
August 16-31	9990.2	N/A	10,000	N/A
September	9990.2	N/A	10,000	N/A
October	N/A	15,000	10,000	34,000
November	N/A	18,000	10,000	34,000
December	N/A	28,000	15,000	34,000
January	N/A	29,000	15,000	34,000
February	N/A	29,000	10,000	34,000
March	N/A	15,000	10,000	34,000
April 1-15	N/A	15,000	10,000	34,000
April 16-30	N/A	15,000	10,000	34,000
May	N/A	10,000	10,000	34,000
June	N/A	10,000	10,000	34,000

(N/A - not applicable)

(1) Mica monthly outflows will be increased in the months from October to June if required to avoid violation of the Flood Control Storage Reservation Curve.

(2) Mica monthly average outflows will be increased in the months from July to March and the month of June if the Arrow reservoir storage in the previous month is within the following limits:

Month	Arrow Reservoir End-of-Month Storage Content (KSFD)	Mica Outflow in Next Month (CFS)
July	0 - 1000	34,000
	1001 - 2100	20,000
August	0 - 1000	30,000
	1001 - 2100	20,000
September	0 - 2000	20,000
October	0 - 1700	23,000
November	0 - 300	34,000
	301 - 1500	31,000
December	0 - 1000	32,000
January	0 - 1000	32,000
February	0 - 1000	17,000
March	-	-
April	-	-
May	0 - 500	24,000
June	0 - 1000	34,000
	1001 - 2100	20,000

If the above table indicates the Mica outflow in August should be increased, the higher outflow applies in the first half only, and the second half of August will be examined using the August 15 Arrow content and the same criteria as for the first half.

(3) Unless an adjustment to the Mica target outflows during January, February, March, or June is required as specified in (2) above, Mica outflow will be reduced to minimum values to maintain the reservoir above the following storage content:

January	7900.0 KSFD
February	7560.6 KSFD
March	6994.6 KSFD
April	6779.0 KSFD
May	7298.2 KSFD
June	8656.9 KSFD

In this situation, the water remaining in Arrow will be sufficient to meet power draft requirements in the United States.

(4) Storage releases from Mica in excess of 7 million acre-feet may be made at the discretion of the Canadian Section of the Operating Committee, and these additional storage releases will be retained in the Arrow reservoir, subject to flood control criteria at Arrow. The total combined storage draft from Mica and Arrow will not exceed 14.1 million acre-feet.

The operating rules set forth above are designed to produce optimum generation in Canada and in the United States, as required by Annex A of the Treaty in the situation where Mica dead storage has been filled. If

this does not occur some modification of the rules may be necessary to ensure adequate and complete drafting of Canadian Treaty storage in Mica reservoir to meet United States power requirements. In that event, such modified rules will be included in the 1979-80 Detailed Operating Plan.

IMPLEMENTATION

The Entities have agreed that each year a Detailed Operating Plan will be prepared for the immediately succeeding operating year. Such Detailed Operating Plans are made under authority of Article XIV 2.(k) of the Columbia River Treaty which states:

> ". . . the powers and the duties of the entities include:
>
> (k) preparation and implementation of detailed operating plans that may produce results more advantageous to both countries than those that would arise from operation under the plans referred to in Annexes A and B."

The Detailed Operating Plan for 1979-80 will reflect the latest available load, resource, and other pertinent data to the extent the Entities agreed these data should be included in the plant. Beginning on 1 January 1979 the Assured Operating Plan contained herein will be reviewed and the data and criteria updated, as agreed by the Entities, to form the basis for a Detailed Operating Plan for the 1979-80 Operating Year. Failing agreement on updating the Assured Operating Plan, the Detailed Operating Plan will include all data and criteria given in this Assured Operating Plan. Actual operation during the 1979-80 Operating Year shall be guided by the Detailed Operating Plan.

The operating rules to be used in implementation of the Detailed Operating Plan are generally the same as the operating rules described in this document.

The values used in the study to define the various rule curves were month-end values only. In actual day-to-day operation it is necessary to operate in such a manner during the course of each month that these month-end values can be observed in accordance with the operating rules. Because of the normal variation of power load and streamflow during any month, straight line interpolation between the month-end points should not be assumed.

During the storage drawdown season, Canadian storage should not be drafted below its month-end point at any time during the month unless it can be conservatively demonstrated that sufficient inflow is available, in excess of the minimum outflow required to serve power demand, to refill the reservoir to its end-of-month value as required. During the storage evacuation and refill season, operation will be consistent with the Flood Control Operating Plan. When refill of Canadian storage is being guided by Flood Control Refill Curves[5/], such curves will be computed on a day-by-day basis using the residual volume-of-inflow forecasts depleted by the volume required for minimum outflow from each day through the end of the refill season.

REFERENCES

1/ Principles and Procedures for the Preparation and Use of Hydroelectric Operating Plans for Canadian Treaty Storage dated 25 July 1967.

2/ Treaty between Canada and the United States of America relating to Cooperative Development of the Water Resources of the Columbia River Basin dated 17 January 1961.

3/ Protocol -- Annex to Exchange of Notes dated 22 January 1964.

4/ Terms of Sale -- Attachment to Exchange of Notes dated 22 January 1964.

5/ Columbia River Treaty Flood Control Operating Plan, dated October 1972.

6/ BPA Hydroelectric Power Planning Program, Assured Operating Plan 30-Year System Regulation Study 80-41, dated 15 July 1974.

7/ Extension of Modified Flows through 1958, Water Management Subcommittee of CBIAC, dated June 1960.

8/ Summary of End-of-Month Reservoir Storage Requirement from Columbia River Flood Regulation Studies dated April 1973.

TABLE 1

COLUMBIA RIVER TREATY
COMPOSITE CRITICAL RULE CURVES
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1979-80 OPERATING YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1ST YR	7814.6	7814.6	7613.7	7314.9	6908.6	5660.9	3714.1	1960.2	1949.9	880.8	2331.3	5763.6
2ND YR	6871.2	6849.1	6264.5	5431.6	4564.3	3314.4	1450.0	594.2	509.7	771.8	1844.8	3626.5
3RD YR	5322.7	5733.1	5459.3	4760.6	4108.3	2465.7	1146.9	99.7	75.6	64.2	1092.2	2459.5
4TH YR	3275.0	3170.7	2944.9	2178.8	1633.4	817.6	25.6	0.0	0.0	0.0	0.0	0.0

TABLE 2

COLUMBIA RIVER TREATY
COMPOSITE ASSURED REFILL CURVE
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1979-80 OPERATING YEAR

JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
0.0	320.0	1432.4	1766.9	1923.8	1990.1	2047.7	1736.4	2178.8	1893.9	3341.5	6203.5	7814.6

TABLE 3
COLUMBIA RIVER TREATY
COMPOSITE VARIABLE REFILL CURVES
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1979-80 OPERATING YEAR

FLOW YEAR	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29							6191.7	5941.3	6156.2	5849.7	5999.2	6953.1	7814.6
1929-30							3618.7	3258.6	3491.6	3623.4	4743.9	6619.3	,,
1930-31							4182.4	3976.8	4198.4	4069.2	4650.0	6749.1	,,
1931-32							0.0	0.0	0.0	0.0	1010.9	4841.4	,,
1932-33							,,	,,	,,	,,	990.1	4500.1	,,
1933-34							,,	,,	,,	,,	1324.1	5419.6	,,
1934-35							919.3	577.8	674.9	944.6	2292.2	5210.1	,,
1935-36							993.4	658.8	574.2	692.8	2430.7	6033.2	,,
1936-37							6242.5	6021.3	5951.8	5762.3	5963.8	6928.3	,,
1937-38							291.5	90.7	39.8	296.1	1985.9	5232.1	,,
1938-39							3645.1	3426.2	3681.1	3704.8	4619.2	6921.1	,,
1939-40							3144.9	2795.1	2990.2	3222.0	4162.5	6655.9	,,
1940-41							4900.4	4677.6	4971.6	5330.3	5756.1	6924.5	,,
1941-42							2714.1	2330.1	2441.7	2723.6	3800.2	6148.9	,,
1942-43							1957.4	1563.1	1500.8	2138.3	3704.2	5760.6	,,
1943-44							6520.8	6294.1	6240.5	5986.9	6188.1	7139.3	,,
1944-45							6237.9	5979.8	6039.6	5806.3	5993.4	6990.0	,,
1945-46							0.0	0.0	0.0	0.0	1010.7	5059.8	,,
1946-47							,,	,,	,,	,,	1717.0	5238.0	,,
1947-48							,,	,,	,,	,,	1189.7	5043.3	,,
1948-49							1770.9	1381.5	1620.6	2364.1	3758.5	6653.5	,,
1949-50							13.4	0.0	0.0	0.0	1360.1	4468.7	,,
1950-51							0.0	,,	,,	162.9	1641.8	5278.0	,,
1951-52							336.6	134.9	89.0	374.3	2155.9	5473.8	,,
1952-53							997.2	625.4	600.0	1013.1	2408.2	5396.3	,,
1953-54							0.0	0.0	0.0	0.0	691.1	4418.3	,,
1954-55							252.8	81.8	71.4	295.6	1745.9	4600.0	,,
1955-56							0.0	0.0	0.0	0.0	1435.8	5136.7	,,
1956-57							,,	,,	,,	,,	1304.2	5660.2	,,
1957-58							1524.0	1165.5	1435.7	2370.0	3621.2	6972.4	,,

TABLE 4

FLOOD CONTROL STORAGE RESERVATION CURVES

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KSFO

1979-80 OPERATING YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	705.8	705.8	705.8	705.8	705.8	504.1	397.2	303.0	303.0	324.6	416.4	560.6	705.8
1929-30	,,	,,	,,	,,	,,	,,	385.7	281.3	281.3	304.0	400.8	553.0	,,
1930-31	,,	,,	,,	,,	,,	,,	368.5	248.0	248.0	272.7	377.1	540.9	,,
1931-32	,,	,,	,,	,,	,,	,,	272.2	65.5	65.5	108.9	281.3	609.5	,,
1932-33	,,	,,	,,	,,	,,	,,	,,	,,	,,	94.2	191.5	573.2	,,
1933-34	,,	,,	,,	,,	,,	,,	,,	,,	,,	127.0	339.8	605.5	,,
1934-35	,,	,,	,,	,,	,,	,,	,,	,,	,,	83.7	187.0	488.0	,,
1935-36	,,	,,	,,	,,	,,	,,	,,	,,	,,	119.5	351.9	705.8	,,
1936-37	,,	,,	,,	,,	,,	,,	353.9	219.8	219.8	246.0	356.9	530.9	,,
1937-38	,,	,,	,,	,,	,,	,,	272.2	65.5	65.5	83.7	217.3	542.4	,,
1938-39	,,	,,	,,	,,	,,	,,	,,	,,	,,	107.4	385.7	705.8	,,
1939-40	,,	,,	,,	,,	,,	,,	,,	,,	,,	103.5	,,	,,	,,
1940-41	,,	,,	,,	,,	,,	,,	321.1	156.3	156.3	186.0	311.0	508.2	,,
1941-42	,,	,,	,,	,,	,,	,,	302.0	121.0	121.0	155.2	291.9	483.0	,,
1942-43	,,	,,	,,	,,	,,	,,	305.0	126.0	126.0	172.9	248.0	647.8	,,
1943-44	,,	,,	,,	,,	,,	,,	392.7	294.4	294.4	316.6	410.4	557.6	,,
1944-45	,,	,,	,,	,,	,,	,,	361.5	234.4	234.4	236.9	349.9	567.7	,,
1945-46	,,	,,	,,	,,	,,	,,	272.2	65.5	65.5	95.8	322.1	647.3	,,
1946-47	,,	,,	,,	,,	,,	,,	,,	,,	,,	101.8	314.1	629.7	,,
1947-48	,,	,,	,,	,,	,,	,,	,,	,,	,,	65.5	300.4	705.8	,,
1948-49	,,	,,	,,	,,	,,	,,	348.3	208.7	208.7	236.9	408.8	,,	,,
1949-50	,,	,,	,,	,,	,,	,,	272.2	65.5	65.5	84.7	184.0	525.3	,,
1950-51	,,	,,	,,	,,	,,	,,	,,	,,	,,	103.3	285.3	534.4	,,
1951-52	,,	,,	,,	,,	,,	,,	,,	,,	,,	67.5	92.2	255.1	,,
1952-53	,,	,,	,,	,,	,,	,,	,,	,,	,,	84.7	234.4	522.8	,,
1953-54	,,	,,	,,	,,	,,	,,	,,	,,	,,	84.2	236.9	547.5	,,
1954-55	,,	,,	,,	,,	,,	,,	,,	,,	,,	80.6	154.7	488.5	,,
1955-56	,,	,,	,,	,,	,,	,,	,,	26.7	26.7	26.7	239.9	578.2	,,
1956-57	,,	,,	,,	,,	,,	,,	,,	65.5	65.5	89.7	376.1	655.9	,,
1957-58	,,	,,	,,	,,	,,	,,	,,	,,	,,	96.3	359.4	705.8	,,

TABLE 5

FLOOD CONTROL STORAGE RESERVATION CURVES

ARROW

KSFO

1979-80 OPERATING YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	3579.6	3579.6	3579.6	3453.6	3453.6	3075.4	3075.4	3075.4	3075.4	3111.2	3235.8	3579.6	3579.6
1929-30	,,	,,	,,	,,	,,	,,	3060.8	3047.7	3033.1	3071.9	3207.0	,,	,,
1930-31	,,	,,	,,	,,	,,	,,	3075.4	3075.4	3075.4	3111.2	3235.8	,,	,,
1931-32	,,	,,	,,	,,	,,	,,	2364.6	1719.2	1008.3	1126.8	2224.4	,,	,,
1932-33	,,	,,	,,	,,	,,	,,	,,	,,	,,	1136.6	1761.6	3034.6	,,
1933-34	,,	,,	,,	,,	,,	,,	,,	,,	,,	1784.8	2327.2	3579.6	,,
1934-35	,,	,,	,,	,,	,,	,,	,,	,,	,,	1008.3	1725.8	3034.6	,,
1935-36	,,	,,	,,	,,	,,	,,	,,	,,	,,	1373.4	2134.7	3579.6	,,
1936-37	,,	,,	,,	,,	,,	,,	2998.3	2927.7	2850.6	2902.5	3082.5	,,	,,
1937-38	,,	,,	,,	,,	,,	,,	2364.6	1719.2	1008.3	1278.1	1831.1	3147.5	,,
1938-39	,,	,,	,,	,,	,,	,,	2637.8	2243.6	1805.9	1983.4	2735.1	3579.6	,,
1939-40	,,	,,	,,	,,	,,	,,	2849.6	2645.4	2420.0	2536.0	2999.8	,,	,,
1940-41	,,	,,	,,	,,	,,	,,	3075.4	3075.4	3075.4	3111.2	3235.8	,,	,,
1941-42	,,	,,	,,	,,	,,	,,	2364.6	1719.2	1008.3	1149.5	1934.0	,,	,,
1942-43	,,	,,	,,	,,	,,	,,	,,	,,	,,	1321.9	1440.4	2389.3	,,
1943-44	,,	,,	,,	,,	,,	,,	3075.4	3075.4	3075.4	3111.2	3235.8	3579.6	,,
1944-45	,,	,,	,,	,,	,,	,,	2641.8	2251.6	1818.0	1908.3	2477.0	3368.4	,,
1945-46	,,	,,	,,	,,	,,	,,	2364.6	1719.2	1008.3	1242.3	2201.2	3579.6	,,
1946-47	,,	,,	,,	,,	,,	,,	,,	,,	,,	1360.8	2147.3	,,	,,
1947-48	,,	,,	,,	,,	,,	,,	,,	,,	,,	1183.3	2216.8	,,	,,
1948-49	,,	,,	,,	,,	,,	,,	,,	,,	,,	1375.9	2494.6	,,	,,
1949-50	,,	,,	,,	,,	,,	,,	,,	,,	,,	1113.7	1113.7	2232.5	,,
1950-51	,,	,,	,,	,,	,,	,,	,,	,,	,,	1101.1	1355.2	3338.1	,,
1951-52	,,	,,	,,	,,	,,	,,	,,	,,	,,	1345.1	1792.3	3013.9	,,
1952-53	,,	,,	,,	,,	,,	,,	,,	,,	,,	1172.7	1476.2	,,	,,
1953-54	,,	,,	,,	,,	,,	,,	,,	,,	,,	1134.4	1628.0	1898.2	,,
1954-55	,,	,,	,,	,,	,,	,,	,,	,,	,,	1090.5	1653.7	3224.7	,,
1955-56	,,	,,	,,	,,	,,	,,	,,	857.1	0.0	289.9	1367.3	2763.4	,,
1956-57	,,	,,	,,	,,	,,	,,	,,	1719.2	1008.3	1224.1	2651.4	3579.6	,,
1957-58	,,	,,	,,	,,	,,	,,	,,	,,	,,	1190.9	2242.5	,,	,,

TABLE 6
FLOOD CONTROL STORAGE RESERVATION CURVES
MICA
KSFO
1979-80 OPERATING YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	3529.2	3529.2	3529.2	3428.4	3428.4	3426.4	3406.7	3387.0	3365.3	3380.5	3412.2	3469.7	3529.2
1929-30	,,	,,	,,	,,	,,	,,	3378.5	3332.6	3282.7	3305.9	3353.2	3440.0	,,
1930-31	,,	,,	,,	,,	,,	,,	3428.4	3428.4	3428.4	3437.9	3457.1	3492.9	,,
1931-32	,,	,,	,,	,,	,,	,,	3100.7	2808.2	2480.5	2577.8	2781.5	3149.6	,,
1932-33	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1933-34	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1934-35	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1935-36	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1936-37	,,	,,	,,	,,	,,	,,	3353.2	3283.7	3208.5	3238.3	3300.8	3413.2	,,
1937-38	,,	,,	,,	,,	,,	,,	3100.7	2808.2	2480.5	2577.8	2781.5	3149.6	,,
1938-39	,,	,,	,,	,,	,,	,,	3213.1	3018.5	2806.7	2873.8	3013.9	3267.5	,,
1939-40	,,	,,	,,	,,	,,	,,	3296.8	3174.3	3042.7	3088.1	3182.3	3353.2	,,
1940-41	,,	,,	,,	,,	,,	,,	3428.4	3428.4	3428.4	3437.9	3457.1	3492.9	,,
1941-42	,,	,,	,,	,,	,,	,,	3100.7	2808.2	2480.5	2577.8	2781.5	3149.6	,,
1942-43	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1943-44	,,	,,	,,	,,	,,	,,	3428.4	3428.4	3428.4	3437.9	3457.1	3492.9	,,
1944-45	,,	,,	,,	,,	,,	,,	3214.6	3021.5	2811.3	2878.3	3017.5	3269.6	,,
1945-46	,,	,,	,,	,,	,,	,,	3100.7	2808.2	2480.5	2577.8	2781.5	3149.6	,,
1946-47	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1947-48	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1948-49	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1949-50	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1950-51	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1951-52	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1952-53	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1953-54	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1954-55	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1955-56	,,	,,	,,	,,	,,	3025.0	2067.1	1058.8	100.9	100.9	803.7	2363.6	,,
1956-57	,,	,,	,,	,,	,,	3428.4	3100.7	2808.2	2480.5	2577.8	2781.5	3149.6	,,
1957-58	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,

TABLE 7

COLUMBIA RIVER TREATY
COMPOSITE OPERATING RULE CURVES
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1979-80 OPERATING YEAR

FLOW YEAR	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	7814.6	7814.6	7613.7	7314.9	6908.6	5660.9	3741.4	2079.9	2178.8	1893.9	3341.5	6232.4	7814.6
1929-30	,,	,,	,,	,,	,,	,,	3371.8	2025.1	,,	,,	,,	,,	,,
1930-31	,,	,,	,,	,,	,,	,,	3741.4	2079.9	,,	,,	,,	,,	,,
1931-32	,,	,,	,,	,,	,,	,,	0.0	0.0	0.0	0.0	1010.9	4841.4	,,
1932-33	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	990.1	4500.1	,,
1933-34	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	1324.1	5419.6	,,
1934-35	,,	,,	,,	,,	,,	,,	919.3	577.8	674.9	944.6	2292.2	5210.1	,,
1935-36	,,	,,	,,	,,	,,	,,	993.4	658.2	574.2	692.8	2430.7	5922.3	,,
1936-37	,,	,,	,,	,,	,,	,,	3741.4	2079.9	2178.8	1893.9	3341.5	6232.4	,,
1937-38	,,	,,	,,	,,	,,	,,	291.5	90.7	39.8	296.1	1985.9	5232.1	,,
1938-39	,,	,,	,,	,,	,,	,,	3599.1	2079.9	2161.1	1864.9	3308.4	6232.4	,,
1939-40	,,	,,	,,	,,	,,	,,	3109.7	1928.0	2157.2	1873.4	3310.6	,,	,,
1940-41	,,	,,	,,	,,	,,	,,	3741.4	2079.9	2178.8	1893.9	3341.5	,,	,,
1941-42	,,	,,	,,	,,	,,	,,	2698.7	1886.6	2133.1	1858.9	3307.7	6023.1	,,
1942-43	,,	,,	,,	,,	,,	,,	1957.4	1419.4	1500.8	1793.6	3282.2	5732.2	,,
1943-44	,,	,,	,,	,,	,,	,,	3741.4	2079.9	2178.8	1893.9	3341.5	6232.4	,,
1944-45	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1945-46	,,	,,	,,	,,	,,	,,	0.0	0.0	0.0	0.0	1010.7	5059.8	,,
1946-47	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	1717.0	5238.0	,,
1947-48	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	1189.7	5043.3	,,
1948-49	,,	,,	,,	,,	,,	,,	1771.9	1381.5	1339.9	1815.9	3242.1	6206.1	,,
1949-50	,,	,,	,,	,,	,,	,,	13.4	0.0	0.0	0.0	1360.1	4468.7	,,
1950-51	,,	,,	,,	,,	,,	,,	0.0	,,	,,	162.9	1641.8	5278.0	,,
1951-52	,,	,,	,,	,,	,,	,,	336.6	134.9	89.3	374.3	2155.9	5473.8	,,
1952-53	,,	,,	,,	,,	,,	,,	997.2	625.4	600.0	1013.1	2408.2	5396.3	,,
1953-54	,,	,,	,,	,,	,,	,,	0.0	0.0	0.0	0.0	691.1	4418.3	,,
1954-55	,,	,,	,,	,,	,,	,,	252.8	81.8	71.4	295.6	1745.9	4600.0	,,
1955-56	,,	,,	,,	,,	,,	,,	0.0	0.0	0.0	0.0	1435.8	5136.7	,,
1956-57	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	1304.2	5609.7	,,
1957-58	,,	,,	,,	,,	,,	,,	1524.3	1165.5	1165.8	1796.5	3114.0	6232.4	,,

COLUMBIA RIVER TREATY

AGREEMENT

on

DETERMINATION OF DOWNSTREAM POWER BENEFITS RESULTING FROM CANADIAN STORAGE FOR OPERATING YEAR 1979-80

The Columbia River Treaty between Canada and the United States requires that the downstream power benefits resulting from operating plans agreed to by the Entities will be determined in advance by the Entities. The determination of downstream power benefits for the operating year 1979-80 is covered in the attached report, dated September 1974, and is agreed to by the United States Entity and the Canadian Entity.

W. D. Kennedy
Chairman
Canadian Entity

Donald Paul Hodel
Chairman
United States Entity

September 27, 1974
Date of Agreement

DETERMINATION OF DOWNSTREAM POWER BENEFITS RESULTING FROM CANADIAN STORAGE
FOR OPERATING YEAR 1979-80
September 1974

I. Introduction.

The Treaty between Canada and the United States of America and related documents relating to the cooperative development of the water resources of the Columbia River Basin requires that downstream power benefits from Canadian storage be determined in advance by the two entities. The purpose of this report is to set out the results of downstream power benefit computations for the sixth succeeding year, 1979-80, and for the storages for which the Assured Operating Plan was developed.

The procedures followed in the benefit studies are those provided in Annex A, Paragraph 7, in Annex B of the Treaty; in Articles VIII, IX, and X of the Protocol; and in the document, "Procedures for the Determination of Downstream Power Benefits Resulting from Canadian Storage," dated September 9, 1968.

The Canadian Entitlement Benefits were computed as follows:

Step I - based on the total U.S. planned hydro and thermal system with 15½ maf of Canadian storage operated for optimum generation in both countries (80-41 study).

Step II - based on the U.S. base hydro and thermal system with 15½ maf of Canadian storage operated for optimum generation in both countries (80-42 study).

Step III - based on the U.S. base hydro and thermal system operated for optimum generation in U.S. (80-13 study).

In addition to the determination of downstream power benefits for the operating year 1979-80, separate determinations were carried out in accordance with the document, "Operating Plans with Mica Generation," dated 15 November 1971, which was agreed by the Entities to implement the provisions of Annex A, paragraph 7, relating to the limit of year-to-year change in the operation of Canadian storage in operating plans designed to achieve optimum generation at-site in Canada and downstream in Canada and the United States of America.

II. Results of Study.

(a) The Canadian Entitlement, which is one-half the total computed downstream power benefits, was computed to be:

Dependable Capacity = 1,435.0 mw

Average Annual Energy = 558.5 mw

(b) One-half of the downstream power benefits determined for 15 maf of Canadian storage operated for optimum generation in the United States was computed to be:

Dependable Capacity = 1,410.0 mw

Average Annual Energy = 549.0 mw

In accordance with paragraph 4 of the document dated 15 November 1971, the above figures represent the minimum permitted downstream power benefits for the 1979-80 operating year. The computed downstream power benefits exceed these amounts.

III. Effect on Canadian Entitlement.

The Canadian Entitlement to downstream power benefits was sold in the United States of America under the Canadian Entitlement Purchase Agreement dated 13 August 1964. By definition, the Canadian Entitlement for 1979-80 which was sold was that which would have been computed if the 1979-80 Assured Operating Plan had been designed to achieve optimum generation downstream in the United States alone. The Canadian Entitlement determined for the conditions above would have been:

Dependable Capacity = $\frac{1}{2}$ of 2,870 mw or 1,435.0 mw

Average Annual Energy = $\frac{1}{2}$ of 1,116 mw or 558.0 mw

Since the 1979-80 Assured Operating Plan was in fact designed to achieve optimum generation at-site in Canada and downstream in the United States of America, Section 7 of the Agreement requires that "any reduction in the Canadian Entitlement resulting from action taken pursuant to paragraph 7 of Annex A of the Treaty shall be determined in accordance with subsection (3) of Section 6 of this Agreement." The Canadian Entitlement of downstream power benefits under the 1979-80 Assured Operating Plan was determined as:

Dependable Capacity = $\frac{1}{2}$ of 2,870 mw or 1,435.0 mw

Average Annual Energy = $\frac{1}{2}$ of 1,117 mw or 558.5 mw

The comparison indicates no significant differences between the two measurements and therefore there is no reduction of the Canadian Entitlement.

IV. Computation of Entitlement.

The following Tables and Charts are attached and summarize the study:

Table 1. Computation of Canadian Entitlement

The essential elements used in the computation of the Canadian Entitlement as provided in Paragraph 2 and 3 of Annex B are shown in this table.

Table 2. Summary of Power Regulations for the Computation of Canadian Entitlement to Downstream Benefits

This table summarizes the Step I, II, and III regulations by projects.

Table 3. Determination of Load Shape for Steps II and III, Canadian Entitlement Computation

The load shape for Steps II and III carry the same ratio between each month and the annual average as does the Pacific Northwest area load. The Northwest area firm loads on this table were based on the current forecast data. The Grand Coulee pumping load is also included in this estimate.

The firm load for Steps II and III is computed as follows:

(1) Estimate the hydro nominal prime power for the critical period.

(2) Add the thermal from Step I less reserve and minimum thermal generation;

(3) Multiply (2) by the ratio of the area annual average firm load to the area critical period firm load to obtain the annual average firm load for Steps II and III (the ratios used in this study were 0.98721 and 0.95778, respectively);

(4) Pro rate the average annual Step II or III load determined in (3) by months in the ratio that each monthly area load bears to the annual average area load; and

(5) Subtract the thermal in each month to obtain the monthly firm hydro load. The average annual hydro loads for Steps II and III also becomes the firm energy considered usable according to Annex B, Paragraph 3(a).

Chart 1 & 2. Secondary Energy Duration Curve, Steps II and III

These charts are duration curves of the secondary energy for Steps II and III. The secondary energy is the capability each month which exceed the firm hydro loads shown in Table 3. The usable secondary energy shown in average megawatts for each step is computed in accordance with Annex B, Paragraphs 3(b) and 3(c). The "other usable secondary" was computed on the basis of 40% of the remainder after thermal replacement. The thermal replacement was limited to the existing

and scheduled thermal energy capability after allowance for reserve and minimum thermal generation, except when an energy surplus condition occurs; then the thermal replacement must not exceed the total of the thermal energy required to supply firm plus the estimated secondary load.

Thermal Energy Capability - mw	7,773
Less 5% Reserve - mw	389
Less Minimum Thermal Generation	1,793
Thermal Replacement - mw	5,591

The following tabulation shows the ordinate values for usable secondary energy:

	Step II	Step III
Thermal Replacement	5,591	5,591
Other	1,370	2,312
Total - mw	6,961	7,903

TABLE 1

COMPUTATION OF CANADIAN ENTITLEMENT

Generation Figures are in Average Megawatts; Load Factors, in Percent

Determination of Dependable Capacity Credited to Canadian Storage

Critical Period Average Rate of Generation with Canadian Storage, Step II	9,069
Critical Period Average Rate of Generation without Canadian Storage, Step III	7,055
Gain Due to Canadian Storage	2,014
Estimated Average Critical Period Load Factor — Percent	70.185
Dependable Capacity Gain 1/	2,870
Canadian Share of Dependable Capacity	1,435

Determination of Increase in Average Annual Usable Energy

Step II (with Canadian Storage)

Annual Firm Hydro Energy	8,881
Thermal Replacement Energy	2,138
Other Usable Secondary Energy	204
System Annual Average Usable Energy	11,223

Step III (without Canadian Storage)

Annual Firm Hydro Energy	6,521
Thermal Replacement Energy	2,978
Other Usable Secondary Energy	607
System Annual Average Usable Energy	10,106

Average Annual Usable Energy Gain	1,117
Canadian Share of Average Annual Energy Gain	558.5

1/ Dependable capacity gain credited to Canadian storage equals gain in critical period average rate of generation divided by the estimated average critical period load factor.

SUMMARY OF POWER REGULATIONS FOR 1979-80
FOR THE
COMPUTATION OF CANADIAN ENTITLEMENT
TO DOWNSTREAM BENEFITS

TABLE 2

PROJECTS	BASIC DATA		STEP I			STEP II				STEP III			
	Number of Units	Nominal Installed Peaking Capacity mw	Usable Storage 1000 AF	January Peaking Capability mw	Critical Period Average Generation mw	Usable Storage 1000 AF	January Peaking Capability mw	Critical Period Average Generation mw	Average Annual Generation mw	Usable Storage 1000 AF	January Peaking Capability mw	Critical Period Average Generation mw	Average Annual Generation mw
CANADIAN													
Mica			7,000			7,000							
Arrow			7,100			7,100							
Duncan			1,400			1,400							
Subtotal			15,500			15,500							
BASE FEDERAL SYSTEM													
Hungry Horse	4	328	3,161	165	102	3,008	246	115	103	3,008	280	212	101
Albeni Falls	3	49	1,155	21	24	1,155	22	22	22	1,155	23	25	25
Grand Coulee	24 + 2	6,529	5,232	5,779	1,999	5,072	6,475	1,769	2,337	5,072	6,045	1,225	2,267
Chief Joseph	27	2,412		2,412	1,090		2,412	1,001	1,330		2,412	710	1,259
Ice Harbor	6	693		693	212		693	218	298		693	164	299
McNary	14	1,127		1,127	640		1,124	591	760		1,124	429	712
John Day	16	2,484	535	2,484	924		2,484	925	1,266		2,484	680	1,231
The Dalles	22	2,018		2,018	817		2,018	796	1,041		2,018	631	1,020
Bonneville	10	574		574	554		574	545	551		574	457	533
Subtotal		16,214	10,083	15,273	6,362	9,235	16,048	5,982	7,708	9,235	15,653	4,533	7,447
BASE SYSTEM NON-FEDERAL													
Kootenay Lake (Canadian)			787			427				427			
Kerr	3	185	1,219	175	111	1,219	175	101	120	1,219	178	148	122
Thompson Falls	6	40		40	36		38	38	32		37	36	31
Noxon Rapids	4	430	251	397	171		430	157	216		430	176	217
Cabinet Gorge	4	230		230	111		230	99	129		230	111	129
Box Canyon	4	74		70	46		70	45	48		71	51	48
Coeur d'Alene & Long Lake			327			223				223			
Wells	10	842		842	438		842	410	515		842	288	476
Chelan	2	54	677	50	38	676	50	38	45	676	51	49	45
Rocky Reach	11	1,267		1,267	591		1,267	553	716		1,267	393	672
Rock Island	18	544		544	279		544	262	332		544	182	304
Wanapum	10	986		986	558		986	524	661		986	366	600
Priest Rapids	10	912		912	530		912	498	624		912	357	567
Brownlee	4	450	980	450	221	974	450	252	265	974	450	251	258
Oxbow	4	220		220	93		220	110	117		220	114	117
Subtotal		6,234	4,221	6,183	3,223	3,519	6,214	3,087	3,820	3,519	6,218	2,522	3,586
TOTAL BASE SYSTEM HYDRO		22,448	29,804	21,456	9,585	28,254	22,262	9,069	11,528	12,754	21,871	7,055	11,033
ADDITIONAL STEP I PROJECTS													
Libby	4	483	4,934	230	191								
Boundary	4	650		650	360								
Spokane River Plants		153		147	89								
Hells Canyon	3	450		450	178								
Dworshak	3	460	2,015	400	164								
Lower Granite	6	930		930	221								
Little Goose	6	930		930	221								
Lower Monumental	3 - 6	466		466	220								
Pelton and Round Butte		454	274	423	132								
Subtotal		4,976	7,223	4,626	1,776								
Independent Resources		4,610	8,489	3,672	1,716								
TOTAL HYDRO RESOURCES		32,034	45,516	29,754	13,077								
MISCELLANEOUS CONTRACTS				128	12								
THERMAL RESOURCES													
Existing Thermal Plants				1,425	516								
Centralia #1, #2, & #3				2,100	1,890								
Trojan				1,130	1,017								
Jim Bridger #1, #2, #3, & #4				2,000	1,800								
Colstrip #1 & #2				330	297								
WPPSS #2				1,100	990								
Colstrip #3 & #4				980	813								
Boardman Coal				500	450								
TOTAL THERMAL RESOURCES				9,565	7,773								
TOTAL IMPORTS				394	609								
TOTAL RESOURCES (HYDRO AND THERMAL)				39,841	21,471								
RESERVES 1/				-2,623	-389								
RESOURCES AVAILABLE FOR LOAD				37,218	21,082								
ESTIMATED LOAD													
Pacific Northwest Area				32,787	20,621								
SURPLUS OR (DEFICIT)				4,431	461								
CRITICAL PERIOD													
Starts:			August 16, 1928			September 1943				September 16, 1936			
Ends:			February 1932			April 1945				April 15, 1937			
Length (Months):			42-1/2 Months			20 Months				7 Months			
STUDY IDENTIFICATION			80-41			80-42				80-13			

1/ Peak reserves are 8% of peak load; energy reserves are 5% of thermal plant energy capability.

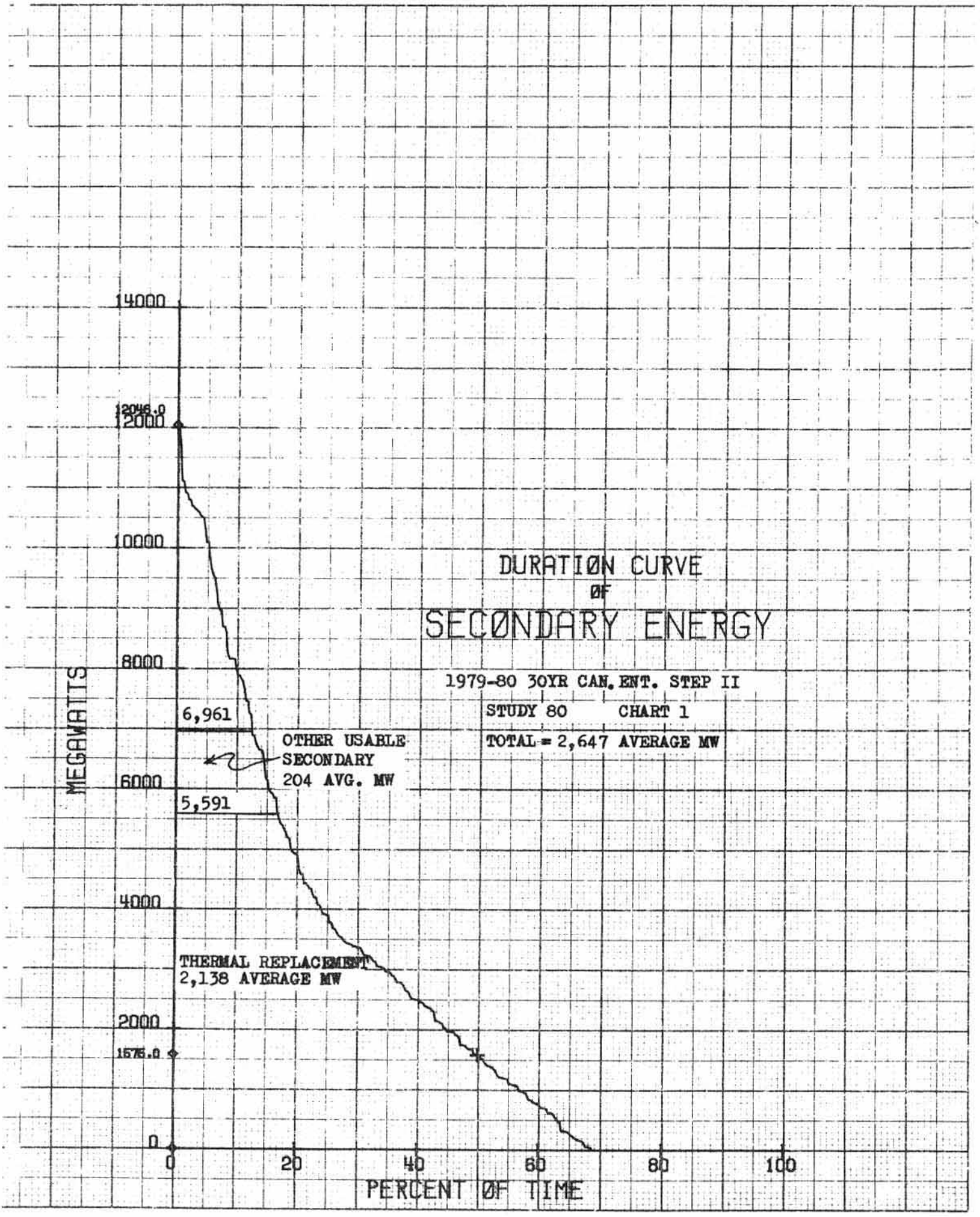
DETERMINATION OF LOAD SHAPE FOR STEP II AND III
1979-80 CANADIAN ENTITLEMENT COMPUTATIONS

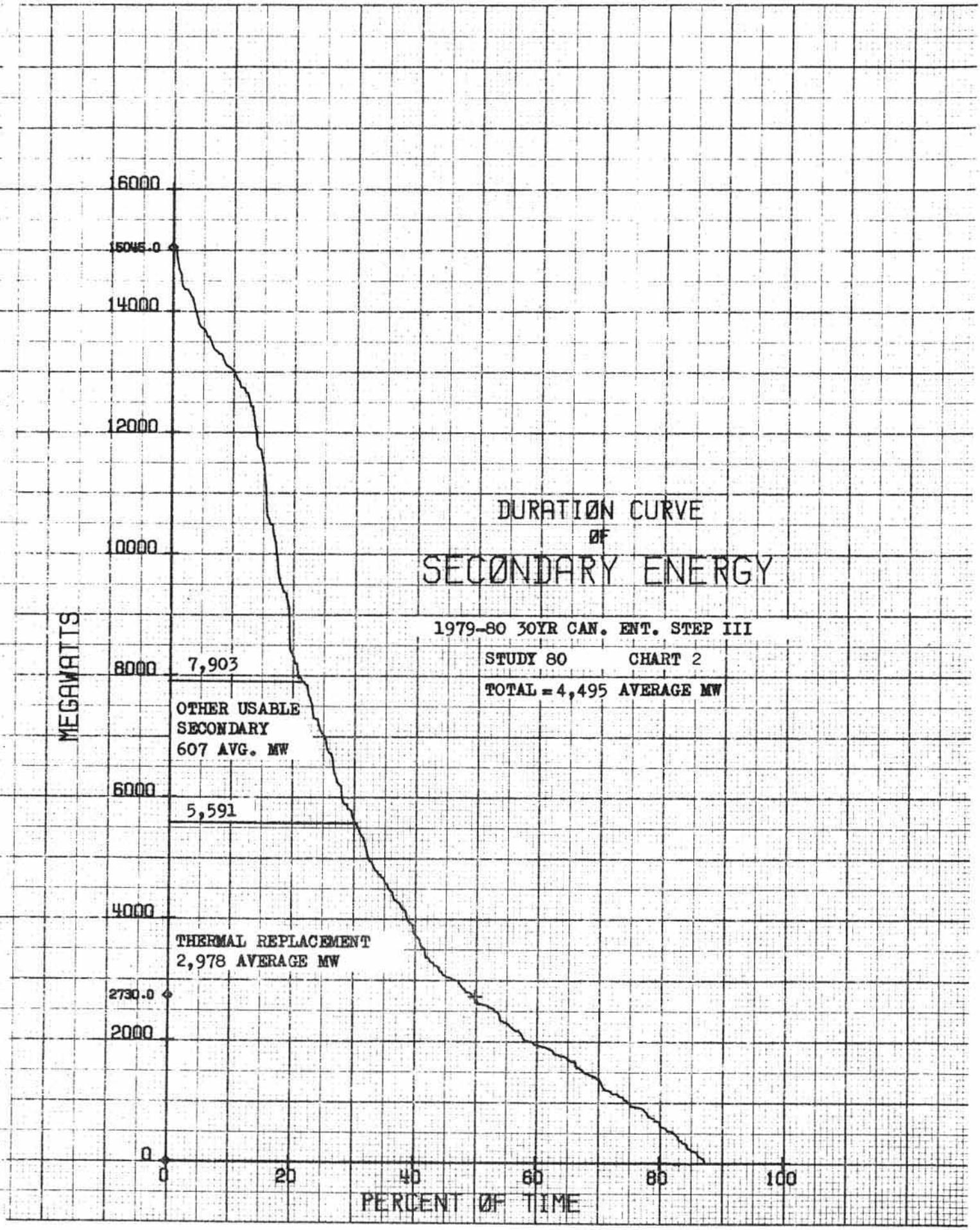
	Pacific Northwest Area Load			Step II			Step III		
	Peak	Avg.	Load Factor %	Total Firm Load 1/	Thermal Firm Load	Hydro Firm Load	Total Firm Load 1/	Thermal Firm Load	Hydro Firm Load
July	26,677 *	18,837	70.61	13,282	5,591	7,691	11,115	5,591	5,524
Aug. 1-15	27,044 *	18,904	69.90	13,329	5,591	7,738	11,155	5,591	5,564
Aug. 16-31	26,966 *	18,807	69.74	13,260	5,591	7,669	11,098	5,591	5,507
Sept. 1-15	27,355 *	18,667	68.24	13,162	5,591	7,571	11,015	5,591	5,424
Sept. 16-30	27,310 *	18,629	68.21	13,135	5,591	7,544	10,993	5,591	5,402
October	29,074 *	19,587	67.37	13,810	5,591	8,219	11,558	5,591	5,967
November	29,903 *	21,127	70.65	14,896	5,591	9,305	12,467	5,591	6,876
December	32,663 *	22,843	69.94	16,106	5,591	10,515	13,479	5,591	7,888
January	32,787 *	23,528	71.76	16,589	5,591	10,998	13,883	5,591	8,292
February	30,873 *	22,344	72.37	15,754	5,591	10,163	13,185	5,591	7,594
March	29,561 *	21,186	71.67	14,938	5,591	9,347	12,501	5,591	6,910
Apr. 1-15	28,140 *	20,199	71.78	14,242	5,591	8,651	11,919	5,591	6,328
Apr. 16-30	28,149 *	20,253	71.95	14,280	5,591	8,689	11,951	5,591	6,360
May	28,446 *	19,709	69.29	13,896	5,591	8,305	11,630	5,591	6,039
June	28,197 *	19,516	69.21	13,760	5,591	8,169	11,516	5,591	5,925
Critical Period Avg.		20,621	70.185	14,660	5,591	9,069	12,646	5,591	7,055
Annual Average		20,526		14,472	5,591	8,881	12,112	5,591	6,521
January Peak	32,787 *								
Step I Critical Period Aug. 16, 1928 - Feb. 29, 1932 42-1/2 Months				Critical Period Sept. 1943 - Apr. 1945 20 Months			Critical Period Sept. 16, 1936 - Apr. 15, 1937 7 Months		

1/ Total firm load of Step II and Step III systems, computed for each system to have an average energy load equivalent to the average energy capability within the critical period and to bear a constant ratio, month by month, to the Pacific Northwest Area Load.

* Figures so marked are peak megawatts. All other figures are monthly or semi-monthly energy in average megawatts.

TABLE 3


DURATIØN CURVE
ØF
SECØNDARY ENERGY
1979-80 30YR CAN. ENT. STEP II
STUDY 80 CHART 1
TOTAL = 2,647 AVERAGE MW
MEGAWATTS
14000
12046.0
12000
10000
8000
6,961
OTHER USABLE
SECONDARY
204 AVG. MW
6000
5,591
4000
THERMAL REPLACEMENT
2,138 AVERAGE MW
2000
1575.0
0
0
20
40
60
80
100
PERCENT ØF TIME


DURATIØN CURVE
ØF
SECØNDARY ENERGY
1979-80 30YR CAN. ENT. STEP III
STUDY 80 CHART 2
TOTAL = 4,495 AVERAGE MW
MEGAWATTS
16000
15045.0
14000
12000
10000
8000
7,903
OTHER USABLE
SECONDARY
607 AVG. MW
6000
5,591
4000
THERMAL REPLACEMENT
2,978 AVERAGE MW
2730.0
2000
0
0
20
40
60
80
100
PERCENT ØF TIME